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Decision making tool for determining the points of innovation and technological development of the region

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Abstract. A research purpose is to modify the model of a patent landscape on an algorithm for the complex construction of the technological landscape, taking into account the ecological and economic features of the region. Technological landscape as a management tool for determining the points of innovation and technological development involves three basic stages. The first stage is to analyze the ecological and resource conditions in the region. The second is to build the model of the well-known patent landscape. In the third stage, identification of the chosen direction, affect investment and development opportunities are presented to support the innovation and technological development of the region. Technological landscape opportunities in the direction of iron metallurgy are constructed for the Sverdlovsk region. The methodology of building technological landscapes over time may be useful in the construction and analysis of the technological trend of the studied direction.

Keywords: innovation, technological landscape, region, patent information

1. Introduction

In the modern world, the processes of technological development of the region are characterized by spatial and temporal heterogeneity in conditions of different scales, which creates difficulties in predicting the technological development of the region [1-3]. In a rapidly changing market, regions are forced to constantly adjust their development strategy. The adoption of tactical / strategic decisions on the choice of new technologies in connection with the increasing rate of change in the competitive environment requires ready-made tools for the processing of operational information [4]. To understand the processes from creating new knowledge to turning it into a technological solution, Fleming and Sorenson [5] introduced the term technological landscape of innovation. With quite frequent use of the term technological landscape (TL); there is no uniform terminology and methodology for constructing and analyzing TL in the literature. Different researchers understand TL: complex descriptions of key factors affecting the development of technology [6], the geographical space occupied by the industrial complex and characterized by a certain set of indicators, visualization of links between developers, venture companies, universities, etc.

The patent landscape is suitable for research planning in virtually any field of technology. Patent landscaping tools are developed at different levels of detail. Information obtained from the patent is open, verified and provides insight into many areas, including field-wide trends affecting the field of



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technology as a whole; active competitors; trends affecting specific technological subsystems; geographic information about the research activity locations [7, 8].

In this paper, it is proposed to build a technological landscape of the region, taking as a basis the methodology of the patent landscape, supplemented by an ecological and economic analysis of the region's resilience and the determination of growth points of the chosen direction

2. Algorithm of the technological landscape construction

Under the TL of the region, we will understand the information and analytical tool for processing open data on the situation in the region (geographical location, current economic activity, economic status, educational activity, investment opportunities, etc.), patent documentation in technological areas relevant for the region, published scientific research for determining the development potential of the region and developing management decisions.

The three basic stages of technological landscape tool are shown in figure 1.

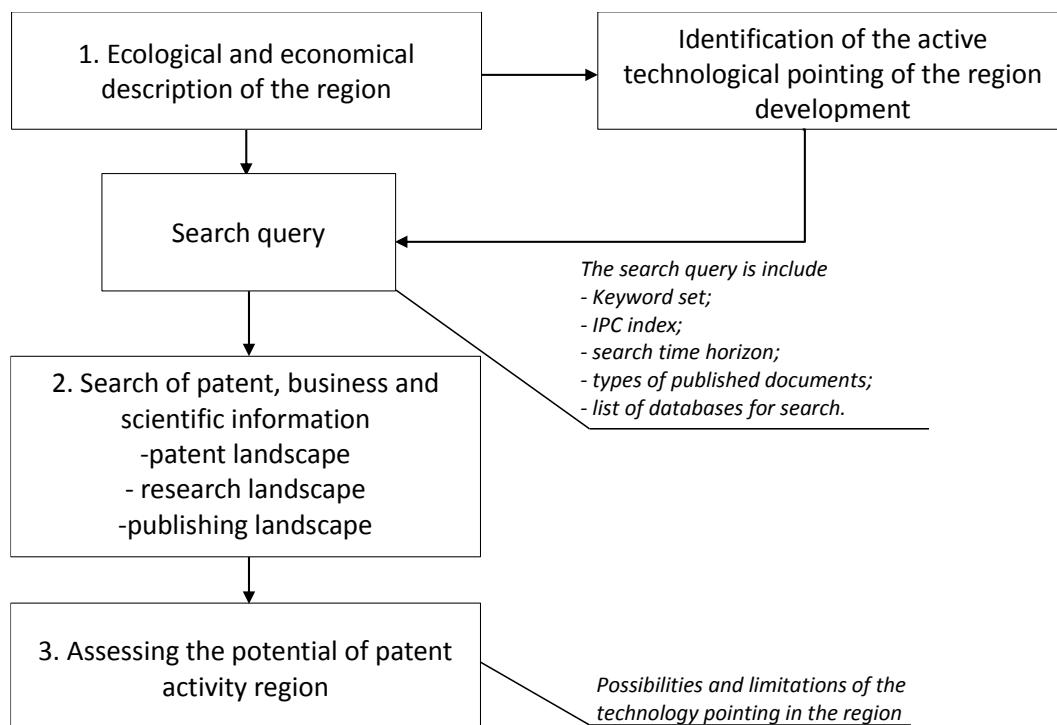


Figure 1. Algorithm of the technological landscape

The first stage is the ecological, economical and resource conditions in the region. This description shows active technological pointing of the region development. As various corporation are more active than others, and specialize in various specific technologies, so too a particular region is more active or prolific than others, and can be seen to host research specialized in certain specific areas of technology. Geographical location is involved in the formation of a search query. At this stage, we define research field, keyword set, search time horizon, index of the International Patent Classification (IPC) [9], list of the databases and types of published documents (research articles, reviews, books, cited patents et al).

The second is to build patent, publishing and research landscapes by search query. Search of patent, business and scientific information is carried out in accordance with Guidelines for Preparing Patent Landscape Reports [10] for all selected databases.

The results of the third stage are the list of active technological pointing, their possibilities and limitations and the planning innovation activities and the formation of regional policy.

3. The technological landscape construction by example Sverdlovsk region

Sverdlovsk region is a federal subject of Russia located in the Ural Federal District. The area has continental climate patterns, with long cold winters (average temperatures reaching -15°C) and short warm summers (average temperatures reaching $+17^{\circ}\text{C}$). 12% of Russia's iron and steel industry is still concentrated in Sverdlovsk region.

3.1. Ecological and economical description of Sverdlovsk region

Some key features of Sverdlovsk region are following. Area is near 194300 km². Population is about 4.3 million people, of which 89% is urban. In the region economy, the main share (31%) is ferrous metallurgy. The region is rich in iron. Explored reserves (resources) in terms of iron amount to 12 billion tons. Gross regional product in prices of 2018 amounted to \$ 30 billion.

The region has the largest full-cycle ferrous metallurgy enterprises: Kachkanarsky Ore Mining and Processing Enterprise, Nizhny Tagil Iron and Steel Plant and other. In the 2000s, there was a restructuring, modernization and reconstruction at metallurgical enterprises. The search time horizon is 2000 year. We will analyze the research articles and patent documents published from 2000 to 2017. The active technological field is iron metallurgy. Manufacture of iron or steel (C21B index IPC [9]) was selected.

3.2. Search of patent, business and scientific information about Sverdlovsk region

Information sources in this study were the full-text database of Russian Patented Inventions (RUPAT) for building of the patent landscape and Web of Science Core Collection (WoS) for publishing landscape. We investigated research article and patents that cite the subject patents during eighteen years, from 2000 to 2017. Results of the information search are presented in table 1.

Table 1 Results of the search query

Database	Document types	Time period	Keys	Number of documents
RUPAT	Patent	2000-2017	Manufacture of iron or steel C21B	61
WoS	Research article and Proceeding	2000-2017	Topic: (iron metallurgy) and Address: (Russia)	67

A total of 61 patent and 67 publication documents published from 2000 to 2017 were subjected to the analysis. Figure 2 shows publication activity dynamics. Close numbers of published documents speak of a uniform diffusion of fundamental knowledge into applied research. Breakthroughs in the iron industry as a whole are not expected.

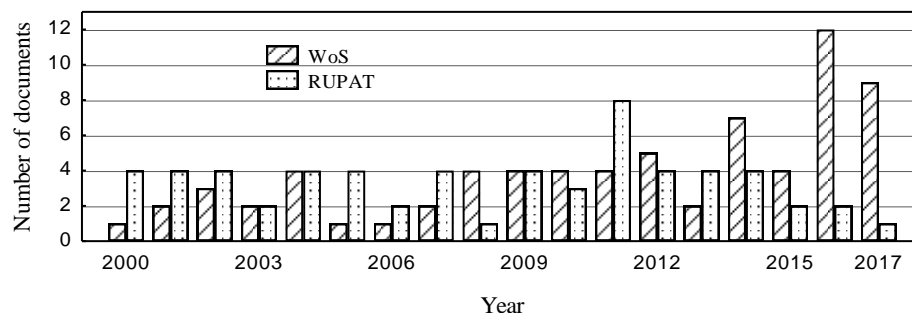


Figure 2. The publication activity dynamics

Concept analysis, semantic analysis, technology domain clustering similar to software Questel Orbit [11] were used to highlight the subject areas and technical solutions. Figure 3

shows the distribution of the main IPC codes contained in the patent, three active technological pointing and basic technological solution. Three active technological pointing are identical to the research areas in which scientific publications were divided in WoS.

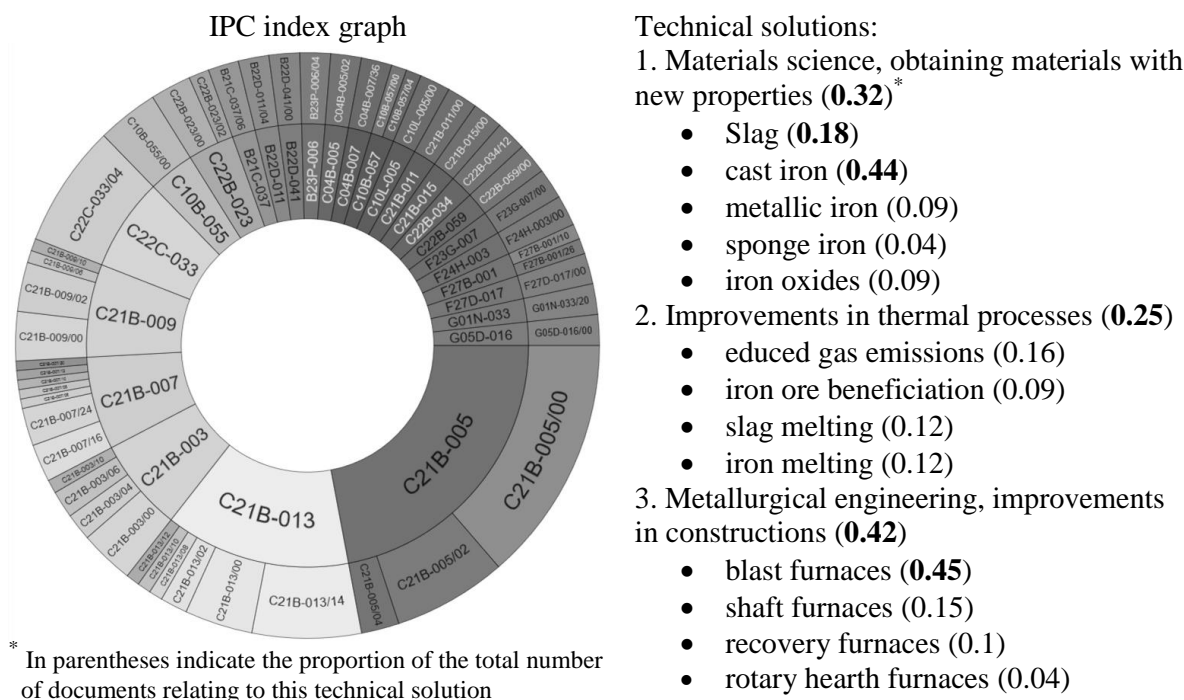


Figure 3. List of active technological pointing and technical solutions in iron metallurgy for Sverdlovsk region

3.3. Assessment of the innovation activity in the region

The list of active technological pointing is shown in iron metallurgy field for Sverdlovsk region on figure 3. Active solutions are shown in bold.

Technological landscape in the iron metallurgical field has become the management tool for determining the points of innovation and technological development of Sverdlovsk region was constructed. These solutions can promote the growth of innovation, and innovation planning and regional policy making will be effective in these areas.

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